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ABSTRACT

This study was designed to examine the relationship between associative clustering, creative potential, and the slope of associative hierarchies. It was predicted that people whose verbal associations are organized into neatly separated clusters will have lower creative potentials as measured by the Remote Associates Test (RAT) and steeper slopes for their associative hierarchies. Thirteen hypotheses were set forth, of which six were supported. However, close examination of the data by complex analysis of variance and posteriori comparisons raised serious question about the interpretability of the findings. Expectations about differential performances on an important subset of RAT items by people with neatly separated clusters vs. people with overlapping clusters were not supported. This may have been due either to errors in conceptualization or flaws in the classification of RAT items. However, the measure of associative clustering again proved highly reliable within persons and deserves further attention. (Author/DD)

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FINAL REPORT

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BASIC COMPONENTS OF COGNITIVE STRUCTURE

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Summary

The study was designed to examine the relationships between associative clustering, creative potential, and the slope of associative hierarchies. Based on prior work in this laboratory and elsewhere, it was predicted that people whose verbal associations are organized into neatly separated clusters will have lower creative potentials as measured by the Remote Associates Test (RAT) and steeper slopes for their associative hierarchies. Thirteen very specific hypotheses were set forth, of which six were supported. However, close examination of the data by complex analysis of variance and posteriori comparisons raised serious question about the interpretability of the findings. Expectations about differential performances on an important subset of RAT items by people with neatly separated clusters vs. people with overlapping clusters were not supported. This may have been due either to errors in conceptualization or flaws in the classification of RAT items. On the other hand, the measure of associative clustering again proved highly reliable within persons and deserves further attention. Suggestions to this effect are incorporated in the text of the Report.

Introduction

Prior work in our laboratory indicated that the degree to which a person's associative clusters are neatly separated is an important aspect of cognitive structure. Specifically, we found that people with overlapping clusters display greater creative potential than people with well separated clusters (Ginsburg & Hood, 1970a), but that they have greater difficulty in switching solution strategies when called for by changes in the task (Ginsburg & Hood, 1970b).

The studies were based on the concept of associative clustering developed by Pollio (1963, 1964; Pollio, Kasschau & DeNise, 1968), who analyzed the bursts in which responses usually are produced in a continuous association task. At about the same time (Ginsburg, 1964) it was suggested that associative clustering might be an important determinant of creative potential. Specifically, it was argued that large separations among associative clusters will inhibit creative thinking while overlap among clusters will facilitate it. Subsequent empirical investigations (Ginsburg & Hood, 1970a) demonstrated that associative clustering is a stable cognitive characteristic (reliability coefficient of .85) and that persons with less separation among clusters showed greater creative potential as measured by the Remote Associates Test (Mednick, 1962). On the other hand, it also was shown that people with less separation among associative clusters do not perform as well on the Water Jar Test as people with widely separated clusters (Ginsburg & Hood, 1970b).

The relationship between associative clustering and creative potential was not simple. It held most strongly for those items on the Remote Associates Test (RAT) whose answers are relatively common associates to one or more of the item stimuli (each RAT item has three stimulus words; the task is to find a fourth word which is associated with all three stimulus words). Items whose answers are common associates were called High Cultural Availability items (Hi CA), and became the focus of our attention (Hood & Ginsburg, 1969, 1970a, 1970b). Our final interpretation, based on the studies of associative clustering and of Cultural Availability, was that people with relatively loose associative clusters are more sensitive to peripheral stimuli and associations, and more capable of using them later, even though the stimuli are only remotely related to the task at hand. That view was consistent with Mendelsohn and Griswold's (1964) findings with respect to RAT performance, and with Dellas and Guier's (1970) contention that openness to stimuli is an important characteristic of the creative person.

Thus, associative clustering emerged as an important variable with respect to creative potential: the less clear the separation among clusters, the greater the probability of normatively uncommon associations, especially when dealing with stimuli which are readily available in the environment but appear peripheral to the task at hand. Associative clustering also seemed important in problem solving in which solution strategies must be altered to meet changes in task structure: the less clear the separation among clusters, the poorer the performance.

These findings and interpretations suggested that the relationships between associative clustering and other aspects of cognitive structure should be studied. Of special interest was the relationship between

associative clustering and the slope of a person's associative hierarchy, since both clustering and slope should influence retrievability of information and perhaps selective receptivity to focal vs. peripheral information.

No studies existed which examined the relationship between clustering and hierarchy slope, but the relationship between RAT performance and hierarchy slope had been studied by Mednick, Mednick and Jung (1964) and by Olczak and Kaplan (1969). Mednick et al. found that high RAT scorers produced a greater number of continuous associations than low scorers, implying a larger and perhaps flatter hierarchy for high scorers.

Olczak and Kaplan found that RAT score did not make a difference in the pattern of inter-response latencies in a continuous association task. However, after characterizing stimulus words in terms the slope of their normative associative hierarchies, Olczak and Kaplan found that the first few responses to flat hierarchy words had longer latencies than the first few responses to steep hierarchy words; but subsequent reaction times to steep hierarchy words increased and eventually approximated the reaction times to flat hierarchy words. They also found that reaction times of associative responses generally increased from the first to sixth response (which was the total number required), lending support to the argument that reaction time is a reasonable operation of strength of association (Garskof, Shapiro & Brandstadter, 1967; Wallenhorst, 1965) or of distance in psychological structure (Peak, 1958) or cognitive structure (Ginsburg & Hood, 1970a).

It was decided to use the same experimental paradigm as Olczak and Kaplan to study the relationship between associative clustering and slope of the associative hierarchy, making necessary modifications for measurement of the clustering variable. Specifically, the objectives were to investigate (1) the relationship between associative clustering and hierarchy slope, (2) the relationship between creative potential and hierarchy slope, (3) the changes in (1) and (2) when we shift from steep hierarchy stimuli (analogous to environmentally common stimuli) to flat hierarchy stimuli, (4) the relationship between associative clustering and creative potential, and (5) the relationship between associative clustering and "cognitive innovation" (McReynolds, 1964), which reflects introduction of change or newness into the cognitive structure.

The first three objectives pertained directly to cognitive structure, with the second objective acting as a replication of the Olczak and Kaplan finding of no relationship between RAT score and hierarchy slope. The fourth objective constituted a replication of our earlier work (Ginsburg & Hood, 1970a), and the fifth objective linked cognitive structure and process so as to lay a groundwork for future studies of mechanisms by which cognitive structure is modified.

Procedures

Four performance measures were obtained: 1. Remote Associates Test (RAT), as a measure of creative potential; 2. Obscure Figures Test (Acker & McReynolds, 1965), as a measure of cognitive innovation;

3. associative clustering, measured in a continuous association task; and 4. associative gradient (slope of associative hierarchy), measured in a limited continuous association task. The RAT and the Obscure Figures Test (OFT) were administered in group session at one sitting (total time, 50 min.). The clustering and gradient measures were obtained at least two weeks later in individual sessions. Procedural details are given below.

Subjects

The RAT and the OFT were administered to all students (about 500) in the Introductory Psychology classes at the University of Nevada, Reno. Their scores on the ten High CA items of the RAT were trichotomized into High, Medium, and Low categories. From the total set of students, 60 were selected for the associative aspects of the study in such a manner that there were 20 High Scorers on the 10 High CA items, 20 Medium Scorers on those items, and 20 Low Scorers.

Remote Associates Test. The RAT (Mednick, 1962; Mednick & Mednick, 1965) is a thirty-item test of creative potential. Each item consists of three stimulus words (e.g., "cottage," "blue" and "mouse") and the task is to specify the word which is associated in any manner whatsoever with all of them (in this case, "cheese"). Special attention will be given to the ten High Cultural Availability items (Hood & Ginsburg, 1969) on which performance was found to relate most strongly to clustering (Ginsburg & Hood, 1970a).

Obscure Figures Test. The OFT (Acker & McReynolds, 1965) also is a purely cognitive test, designed to measure cognitive innovation. It contains 40 items, each being a simple line drawing. The drawings differ in the degree to which they suggest concrete objects, some being deliberately highly ambiguous. The task is to specify something (concrete) that the item could represent, and subjects are instructed to be imaginative in their answers. Responses are coded for degree of imaginativeness according to the procedures specified in McReynolds and Acker (1965).

Associative Clustering. Each person was measured individually. He was asked to respond aloud to each of 15 stimulus words, presented both orally and visually (AFRAID, BUTTER, CHILD, COMMAND, DOORS, JUSTICE, LIFT, OVER, PRIEST, QUIET, ROUGH, STEM, TROUBLE, and WISH). Responses were recorded on audio tape, and the person was allowed to continue responding to a stimulus word either for 4 minutes or until he paused for 45 seconds. Subjects were instructed to look back at the stimulus word after each response and to try to respond to it rather than to their own prior responses so as to minimize chaining. An associative clustering value was computed for each person, based on the tape recording of his responses, as follows: the modal between-response latency was identified for his responses to a given stimulus word (in the absence of a single mode, the median latency was used). Then the standard deviation of his between-response latencies was calculated and added to the modal latency. The sum is called the "burst boundary value" for that stimulus word for that person. Any temporal separation between responses which exceeds the burst boundary value indicates the end of

one burst and the start of another, thereby allowing a person's responses to a stimulus word to be clustered into bursts of responses. A ratio of the average between-burst latencies to the average within-burst latencies was computed for each stimulus word for a person; the mean of the 15 individual stimulus word ratios was then calculated and used to represent the degree of associative clustering for that person. The greater the ratio of between-burst latencies to within-burst latencies, the more clearly separated the person's associative clusters (i.e., the less overlap among them). High within-person reliability of the ratio scores across the 15 stimuli was found in prior work ($r = .85$; cf. Ginsburg & Hood, 1970a, fn. 3).

A minor point should be noted here because it will be pertinent later: the latency of the first response to a stimulus word is presumed to be a response to silent vocalization of the stimulus word and therefore is counted as a within-burst latency.

Associative Gradient (Slope). This was based heavily on the procedures used by Olczak and Kaplan (1969). Slope data were gathered in individual sessions. The subject was asked to give 6 responses to each of 20 stimulus words. Ten of the stimuli were Steep Hierarchy words (black, table, butter, blossom, boy, lamp, man, scissors, woman, bed) and 10 were Flat Hierarchy words (baby, cheese, people, whistle, butterfly, child, street, cars, memory, doctor), as reported by Mednick, Mednick & Jung (1964). The order of presentation of Steep and Flat words was balanced across subjects, and all responses were recorded on audio tape. Since whether a person responds to his own prior responses (chaining) can greatly influence the picture we get of his cognitive structure, it was important to include both CHAIN and NO-CHAIN instructions in the study, thereby going beyond the design of Olczak and Kaplan (1969) who used only a NO-CHAIN condition. Thus, each subject received 5 Flat stimuli and 5 Steep stimuli under each chain condition, with the orders appropriately balanced across subjects. Under the CHAIN condition, the between-response intervals were measured as for associative clustering. Under the NO-CHAIN condition, the experimenter presented the word 6 times, and the between-response latencies were measured from the onset of the experimenter's oral presentation to the onset of the subject's subsequent response. Both measures (i.e., that taken under CHAIN and that taken under NO-CHAIN instructions) allowed the calculation of between-response latencies for all six responses to each stimulus. Subsequently, for each person, the mean of his latencies for each response (first through sixth) to certain subsets of 5 stimulus words was computed and used as the raw data for that person. The particular subsets of stimuli for which the means were computed are identified in the following Design section.

Design

In a study of this form, a schematic layout of the analysis design is essential. The basic design was a four-factor analysis of variance with repeated measurement on three of those factors (Winer, 1962). The factors were:

A. Score on High CA RAT items (high, medium, or low)--a subject classification variable.

B. Instructional Set (CHAIN vs. NO-CHAIN)--subjects received both levels, with order balanced across subjects.

C. Stimulus Word Slope (Flat vs. Steep)--subjects received both levels, with order balanced across subjects.

D. Trials (the 6 responses a subject makes to each stimulus word)--subjects appeared in all 6 levels, with order necessarily fixed from 1 to 6.

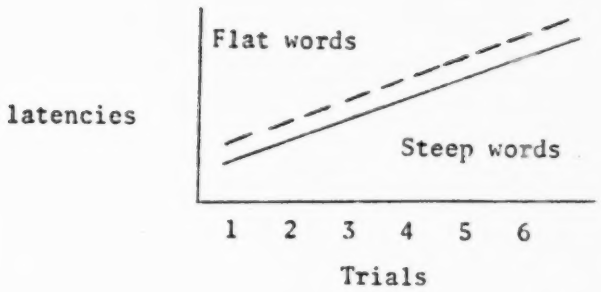
A schematic layout is given below:

	b_1: NO-CHAIN												b_2: CHAIN											
	c_1: FLAT WORD						c_2: STEEP WORD						c_1: FLAT WORD						c_2: STEEP WORD					
Trials:	d_1	d_2	d_3	d_4	d_5	d_6	d_1	d_2	d_3	d_4	d_5	d_6	d_1	d_2	d_3	d_4	d_5	d_6	d_1	d_2	d_3	d_4	d_5	d_6
a_1: High RAT																								
a_2: Med RAT																								
a_3: Low RAT																								

There were 20 different people in each level of A, and those 20 reappeared in every cell in their assigned row. Each cell contained a datum on each of 20 persons, with each datum being the mean of a person's latencies to 5 stimulus words. For example, the datum for a person in the upper left cell ($a_1 b_1 c_1 d_1$) would be: the mean of the latencies of his first response to each of the 5 Flat Slope stimuli which he received under the NO-CHAIN instructional condition. The person, of course, is a High Scorer on the High CA RAT items (indicated by his presence in row a_1). The entry for that person in cell $a_1 b_1 c_1 d_2$ would be the mean of the latencies of his second response to the 5 Flat Slope stimuli which he received under the NO-CHAIN instructional condition.

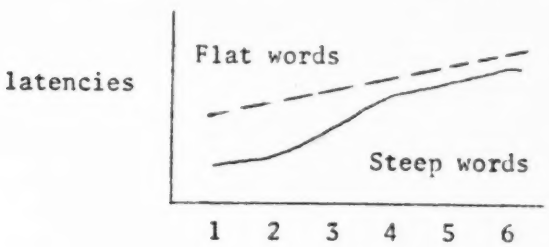
A repeated measures analysis of variance was used to test the following predictions (for which rationales are stated), all of which apply to the NO-CHAIN condition only:

1. For High Scorers (a_1), there will be no significant differences between their latencies to Flat and Steep Slope stimuli.
   Rationale: assuming High Scorers to be "loose cluster" people, they are unlikely to overlearn environmental relationships, so that frequent environmental associations (words with steep slopes) will not be more strongly learned than infrequent associations.



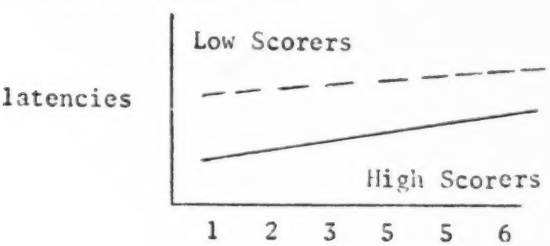
High Scorers on High CA items

2. For Low Scorers (a_3), latencies of their first responses to Steep words will be much shorter than the latencies of their first responses to Flat words, but their subsequent latencies to the two types of words will not differ significantly. Rationale: assuming Low Scorers to be "tight cluster" people, their associative clusters accurately reflect the normative associative slopes of the community. Therefore, their associative hierarchy slopes should reflect those of the community.



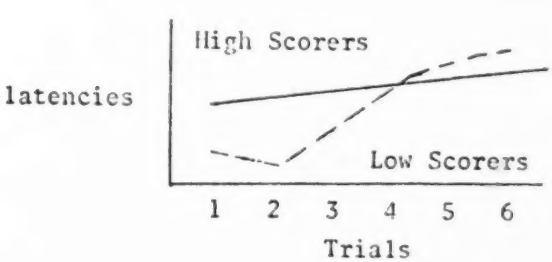
Low Scorers on High CA items

3. High Scorers will respond more rapidly to Flat Slope stimuli than will Low Scorers.



Flat words

4. The shortest latencies of all will be shown by Low Scorers in their first or second response to Steep Slope stimuli.



Steep words

All of the above were repeated using a trichotomization of ratio scores (Associative Clustering) as Factor A:

5-8. Repeat of Predictions 1-4, except Factor A will represent Low, Medium and High ratio scores instead of High, Medium and Low Scorers on High CA RAT items.

9. Scores on the 10 High CA RAT items will be negatively correlated with the ratio scores, with fluency in the clustering task partialled out. That is, score on the High CA RAT items will be negatively related to degree of separation among associative clusters. This is designed as a replication of the central finding of Ginsburg & Hood (1969).

10. Ratio scores will be negatively related to OFT scores. That is, the less the separation among cognitive clusters, the greater the person's capacity for cognitive innovation.

11. Scores on the High CA RAT items will be positively correlated with OFT scores, following the same rationale as in the preceding hypothesis.

Results

The basic data in means, using score on Hi CA RAT items as Factor A, are presented below in Table 1. The table has the same format as the schematic design layout presented earlier. (See page 8 for Table 1.)

The first set of hypotheses concerns performance on the 10 High Cultural Availability (Hi CA) items of the RAT, as identified by Hood and Ginsburg (1969). The Hi CA items are numbers 1, 2, 7, 8, 9, 10, 11, 12, 16 and 19. All of the hypotheses are a priori and were tested accordingly, except where indicated. References to cell numbers pertain to the schematic layout presented earlier and to Table 1. All predictions pertain only to the NO-CHAIN condition.

Planned Comparisons

HYP 1: This hypothesis specifies no difference between the response latencies of high RAT scorers (using only the scores on the 10 Hi CA items) to Flat and Steep Slope stimulus words, within the NO-CHAIN condition. That is, the mean of cell AC_{11} will be equal to that of AC_{12}, averaged over the 6 levels of D (trials) and over the 20 persons within the chosen level of A (high scorers). The hypothesis predicts no difference and therefore must be tested at a large alpha (.25, 2-tailed) to ensure high sensitivity.

The difference between the two means was .144, $t = .534$, $p > .25$. Thus, the hypothesis of no difference is supported.

HYP 2a: Low scorers will respond more rapidly to Steep than to Flat slope stimuli on their first responses. That is, the mean of cell AC_{31} will be greater than that of cell AC_{32}, averaged over the 20 Ss in A_3 and overall 6 trials.

TABLE 1: Mean Latencies in Seconds for RAT Score Groups*

Instruction Set (B)		NO-CHAIN											
Word Slope (C)		Flat						Steep					
Responses (D)		1	2	3	4	5	6	1	2	3	4	5	6
Hi CA RAT Score (A)	High	2.36	1.82	2.08	2.98	3.30	3.76	1.76	1.70	2.48	2.99	4.08	4.15
	Med.	2.24	1.82	2.68	2.81	3.60	3.85	2.18	2.18	2.92	3.38	4.00	4.00
	Low	2.46	2.44	3.00	3.69	4.38	4.28	2.12	2.46	3.16	3.92	5.14	4.82

Instruction Set (B)		CHAIN											
Word Slope (C)		Flat						Steep					
Responses (D)		1	2	3	4	5	6	1	2	3	4	5	6
Hi CA RAT Score (A)	High	2.82	2.26	2.82	3.88	4.66	4.60	2.76	2.04	2.86	4.26	4.48	5.01
	Med.	2.98	2.53	2.97	3.42	4.36	4.46	2.70	3.08	3.44	4.33	4.78	5.67
	Low	3.28	2.95	3.86	3.88	4.98	4.98	3.38	3.08	4.32	4.76	7.12	6.32

*n = 20 per RAT Score group; repeated measures on factors B, C and D.

The difference between means was .335, t = .788, which yielded .20 < p < .25, 1-tailed. Thus, Hyp 2a was not supported, although there was a difference in the predicted direction.

HYP 2b: Latencies of the last few responses of low scorers to Flat and Steep Slope stimuli will be equal. Again, this is a prediction of no difference and therefore requires a large alpha to ensure sensitivity. In terms of cell means, the means of cell AC_{31} and AC_{32}, averaged over the 20 Ss in A_3 and over trials 4, 5 and 6 only, will be equal.

The weighted difference between the cell means was -1.53, t =-2.08, and .02 < p < .05. Thus Hyp 2b was not supported, since the low scorers clearly responded faster to Flat than to Steep Slope words during their last 3 responses.

HYP 3: High scorers will respond more rapidly than low scorers to Flat Slope words. Thus, the mean of cell AC_{11} will be less than that of AC_{31}, averaged over 20 Ss in each level of A and over 6 trials, but for Flat Slope words (C_1) only.

The difference between means was .66, which yielded t = 1.07, .10 < p < .15, 1-tailed. The difference was in the predicted direction, but due to high Subject-within-Group variability did not reach acceptable significance.

HYP 4: The shortest latencies of all conditions will be shown by low scorers in their first or second response to Steep Slope words. In terms of means, the average of cells ACD_{321} and ACD_{322} will be less than the average of any other cell or combination of cells.

Examination of the cell means reveals that the first responses of low scorers to the Steep Slope words were slower than those of high scorers to those words. Thus, the hypothesis is not supported, even in the absence of statistical tests.

To summarize the results concerning the first set of hypotheses, support was poor. As expected, there was no difference between the average response latencies of high and low scores on the 10 Hi CA RAT items to Flat vs. Steep Slope stimuli. Furthermore, low scorers tended to respond more rapidly to Steep than to Flat Slope words on their first responses, and high scorers tended to respond more rapidly than low scorers to Flat Slope words in general; but neither of these two results reached an acceptable level of significance. Finally, the stronger hypotheses (2b, 4) very clearly were not supported. Low scorers responded faster to Flat than to Steep slope words during their last three responses (rather than equally fast), and the first two responses of low scorers to Steep Slope words were slower (rather than faster) than those of high scorers.

The next set of hypotheses, 5-8, are identical to Hypotheses 1-4, except that they pertain to the Cluster Ratio scores ($\bar{Y}$) of the subjects. A high score implies a clear separation between associative clusters, and a low score implies relatively little separation among clusters. The

reliability of the associative clustering index ($\overline{Y}$) was found to be .78, close to the .85 found in earlier work (Ginsburg & Hood, 1970a). Thus, the ratio score is quite stable within each person, under the conditions of testing.

The basic data in means, using $\overline{Y}$ score as Factor A, are given in Table 2. The table follows the format of the schematic layout presented earlier. (See page 11.)

HYP 5: No difference between the response latencies of high $\overline{Y}$ people to Flat and Steep Slope words ($\overline{ABC}_{111} = \overline{ABC}_{112}$, averaged over the 6 trials). The difference between the means was .138, t = .504, p > .30. Thus, no dependable difference was demonstrated, and the hypothesis was supported.

HYP 6a: High $\overline{Y}$s will respond faster to Steep than to Flat words on their first responses ($\overline{ABCD}_{3111} > \overline{ABCD}_{3121}$). The difference between means was .685, t = 1.56, .05 < p < .10 (1-tailed). Thus, the hypothesis was weakly supported, at borderline level.

HYP 6b: Latencies of the last few responses of high $\overline{Y}$s to Flat and Steep words will be equal ($ABCD_{311,4-6} = ABCD_{312,4-6}$). The difference between means was .675, t = .906, .30 < p < .40 (2-tailed). The hypothesis of no difference was supported, but note should be taken that a 1-tailed test would have placed the difference at .15 < p < .20.

HYP 7: Low $\overline{Y}$s will respond more rapidly than high $\overline{Y}$s to Flat Slope words ($ABC_{111} < ABC_{311}$). The difference was .115, t = .192, n.s. The hypothesis was not supported.

HYP 8: The shortest latencies of all conditions will be shown by high $\overline{Y}$s in their first or second response to Steep Slope words. Examination of Table 2 suggests that the most direct test of the hypothesis would be accomplished by comparing $\overline{ABCD}_{3121}$ with the average value of $\overline{ABCD}_{1111}$, $\overline{ABCD}_{1121}$ and $\overline{ABCD}_{3111}$ (i.e., high $\overline{Y}$s, first response to Steep words vs. high $\overline{Y}$s, first response to Flat words and low $\overline{Y}$s, first responses to both Flat and Steep words). The comparison yielded a value of 5.135, t = 1.877, .025 < p < .05 (1-tailed). Thus, the hypothesis was supported: high $\overline{Y}$s do respond very rapidly to Steep Slope words on their first response. However, inspection of Table 2 reveals that the differences between high and low $\overline{Y}$s disappear by their second response, while the medium $\overline{Y}$ group becomes increasingly different. This point will be considered later at length.

To summarize the hypotheses concerning $\overline{Y}$ scores, support was mixed. Support was given to Hyp 5 (a weak hypothesis), borderline support was given to Hyp 6a, support was given to Hyp 6b (a weak hypothesis), Hyp 7 was not supported, and Hyp 8 received strong support. As will be seen, posteriori tests in which attention is given to the medium $\overline{Y}$ group make direct interpretation of Hypotheses 5-8 questionable.

HYP 9: There will be a negative partial correlation between $\overline{Y}$ scores and scores on the ten Hi CA PAT items, with fluency (number of words produced on the $\overline{Y}$ task) held constant. This hypothesis was a replication of earlier work (Ginsburg & Hood, 1970a); it was not supported (r = .012).

TABLE 2: Mean Latencies in Seconds for Cluster ($\bar{Y}$) Groups*

Instruction Set (B)		NO-CHAIN											
Word Slope (C)		Flat						Steep					
Responses (D)		1	2	3	4	5	6	1	2	3	4	5	6
ASSOC. CLUSTER RATIOS (A)	Low	2.36	1.78	2.18	2.88	3.12	3.28	2.08	1.87	2.41	2.93	3.62	3.51
	Med.	2.39	2.54	3.28	3.95	4.86	4.62	2.35	2.52	3.60	4.21	6.11	5.50
	High	2.32	1.76	2.29	2.65	3.29	3.99	1.63	1.96	2.55	3.16	3.49	3.96

Instruction Set (B)		CHAIN											
Word Slope (C)		Flat						Steep					
Responses (D)		1	2	3	4	5	6	1	2	3	4	5	6
ASSOC. CLUSTER RATIOS (A)	Low	2.80	2.12	2.74	3.31	3.74	3.52	3.02	2.22	3.16	3.60	4.04	4.62
	Med.	3.33	3.28	4.02	4.70	5.70	5.54	3.16	3.02	4.36	5.62	7.24	7.24
	High	2.96	2.34	2.89	3.16	4.56	4.47	2.65	2.27	3.08	4.12	5.10	5.14

*n = 20 per Association Cluster Ratio group; repeated measures on factors B, C and D.

HYP 11: There will be a negative correlation between scores on the Hi CA RAT items and OFT scores. The hypothesis received borderline support ($r = -.18$, $.05 < p < .10$, 1-tailed).

Unplanned Comparisons and Posteriori Analyses

Table 3 summarizes the analysis of variance of response latencies, using scores on the ten Hi CA RAT items as Factor A. The a priori tests specified by Hypotheses 1-4 were reported above, and no further tests were conducted because primary interest in this study is on the associative clustering measure ($\overline{Y}$). The analysis of variance of response latencies, using $\overline{Y}$ scores as Factor A, is presented in Table 4. Of course, posteriori analyses which do not pertain to Factor A can be computed from either Table 3 or Table 4 with identical results (see pages 13, 14).

Examination of Table 4 reveals significant effects for A ($\overline{Y}$ score), B (Set), C (Word Slope), D (Responses), AD ($\overline{Y}$ x Response number) and CD (Word Slope x Response number). Since AD and CD interactions are significant, the main effects of A, C and D are not particularly meaningful. Instead, those factors will be examined shortly as simple effects within the interactions. On the other hand, Instructional Set (B) is significant and is not involved in higher order effects. The overall average of the NO-CHAIN conditions was 3.083, and that of the CHAIN conditions was 3.857. Latencies were greater under the CHAIN condition.

A trend analysis of Responses (D) indicates strong linear ($F = 64.30$, $p < .01$) and cubic ($F = 34.65$, $p < .01$) trends, and a moderate but dependable quadratic trend ($F = 6.70$, $.01<p<.05$). The linear and cubic trends together imply a decrease and then continuous increase in response latency, finally leveling out by the fifth response. The trends can be seen in Figures 1 or 2.

Since the CD interaction is significant, a simple effects analysis of C_1 vs. C_2 at each level of D is called for. The differences between C_1 and C_2 at D_1 and at D_2 were not significant; and at D_3, $C_2 - C_1 = .30$, $.10 < p < .25$. However, beginning with the fourth response (D_4), the latency to Steep words was dependably greater than the latency to Flat words ($p < .01$ at D_4, D_5 and D_6, respectively). This can be seen in Figure 1, below; it also appears that the $C_2 - C_1$ difference increases from D_2 to D_5, at which point the two curves level out but maintain the same distance from each other. (See page 15 for Figure 1.)

The AD interaction also is subject to a simple effects analysis at each level of D. This is presented in Table 5 (see page 16).

TABLE 3: Summary Analysis of Variance of Response Latencies

(Hi CA RAT Scores as Factor A)

Source	df	MS	F	s^2
Between Subjects	59			
A: RAT Score Group (H, M, L)	2	87.92	1.13	.02
Subjects within Groups	57	77.57		3.23
Within Subjects	1380			
B: Set (No Chain, Chain)	1	218.80	34.21*	.29
C: Stimulus Word Slope (F,S)	1	45.91	14.54*	.06
D: Response (1-6)	5	235.45	42.43*	.96
AB	2	.49	.08	----
AC	2	3.17	1.00	----
AD	10	2.82	.51	----
BC	1	2.86	.65	----
BD	5	1.51	.76	----
CD	5	8.45	4.54*	.06
ABC	2	4.43	1.01	----
ABD	10	1.52	.76	----
ACD	10	1.58	.85	----
BCD	5	2.30	1.27	.01
ABCD	10	.94	.52	----
B x S.w.Gp.	57	6.40		.53
C x S.w.Gp.	57	3.16		.26
D x S.w.Gp.	285	5.55		1.39
BC x S.w.Gp.	57	4.37		.73
BD x S.w.Gp.	285	2.00		1.00
CD x S.w.Gp.	285	1.86		.93
BCD x S.w.Gp.	285	1.81		1.81
				Σ = 11.28

*$p < .01$

TABLE 4: Summary Analysis of Variance of Response Latencies

($\bar{Y}$ Scores as Factor A)

Source	df	MS	F	s^2
Between Subjects	59			
A: $\bar{Y}$ Score Group (L, M, H)	2	253.63	3.53*	.38
Subjects within Groups	57	71.76		2.99
Within Subjects	1380			
B: Set (No Chain, Chain)	1	219.48	34.75**	.30
C: Stimulus Word Slope (F, S)	1	46.60	14.70**	.06
D: Response (1-6)	5	235.59	45.12**	.96
AB	2	2.42	.38	----
AC	2	2.47	.78	----
AD	10	12.10	2.32**	.10
BC	1	2.18	.49	----
BD	5	1.38	.68	----
CD	5	8.30	4.54**	.05
ABC	2	1.80	.40	----
ABD	10	1.29	.64	----
ACD	10	2.51	1.37	.02
BCD	5	2.44	1.32	.01
ABCD	10	- .09	----	----
B x S.w.Gp.	57	6.32		.53
C x S.w.Gp.	57	3.17		.26
D x S.w.Gp.	285	5.22		1.30
BC x S.w.Gp.	57	4.47		.74
BD x S.w.Gp.	285	2.01		1.00
CD x S.w.Gp.	285	1.83		.92
BCD x S.w.Gp.	285	1.85		1.85
				Σ = 11.47

*p < .05

**p ≤ .01

FIGURE 1: Response Latencies Over Word Slope and Responses

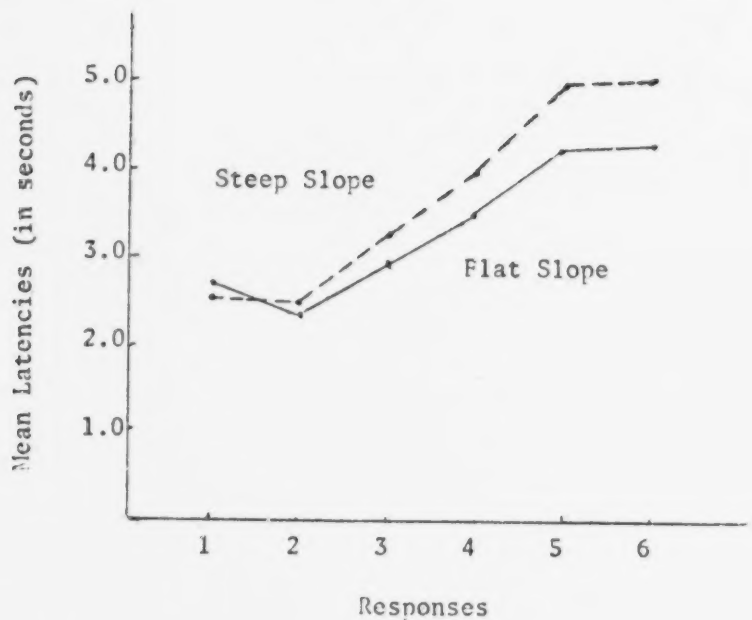
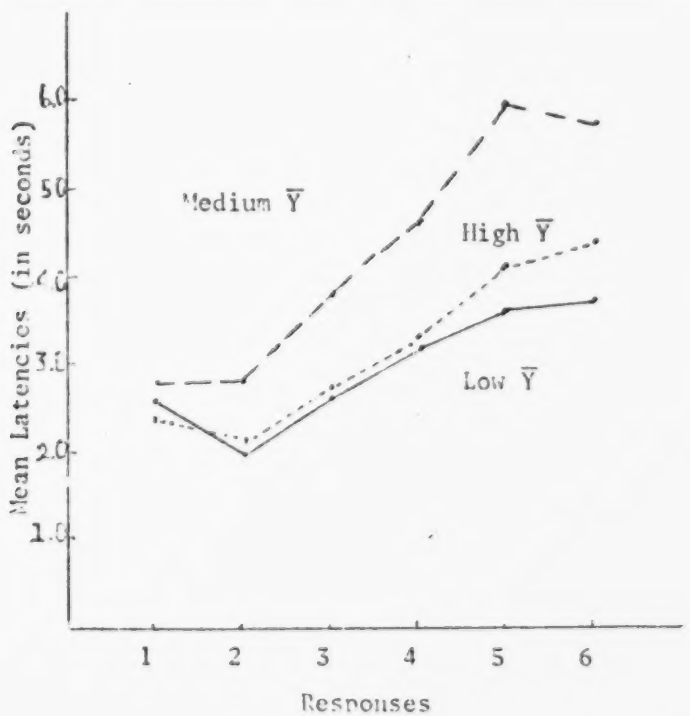


TABLE 5: Simple Effects of A at Each Level of D

SS_A at	$F_{2,342}$	p
d_1: 7.15	.22	n.s.
d_2: 34.64	1.06	n.s.
d_3: 70.87	2.17	$.10 < p < .25$
d_4: 104.03	3.19	$.01 < p < .05$
d_5: 246.76	7.56	$p < .01$
d_6: 164.84	5.05	$p < .01$

By the fourth response, there are dependable differences among the three $\bar{Y}$ groups. Inspection of Figure 2 suggests that the difference is between A_2 (medium Y) and the other two groups. Posteriori tests (Tukey a) on A_2 vs. A_1 and A_3 and on A_3 vs. A_1 at each level D_4, D_5 and D_6, respectively, bore out the inference from Figure 2. Specifically, the medium $\bar{Y}$ group yielded slower response times ($p < .05$) than did the other two groups together, on the fourth, fifth and sixth responses, respectively. On the other hand, the high and low $\bar{Y}$ groups did not differ from each other on any of the last three responses.

FIGURE 2: Response Latencies Over Cluster Ratio Scores ($\bar{Y}$) and Responses



Discussion

In general, the expectations which led to this study were not borne out, although several of the individual hypotheses did receive support. The expected replication of earlier work, predicted in Hypothesis 9, failed to materialize. That is, there was no relationship between performance on the ten Hi CA RAT items and $\overline{Y}$ score, although a prior investigation (Ginsburg & Hood, 1970a) had yielded a partial correlation of .60, with fluency held constant.

The failure to replicate was not due to instability of the clustering score, since the within-person reliability of $\overline{Y}$ scores was found to be .78 in the present study, similar to the .85 obtained in our original study (Ginsburg & Hood, 1970a). Moreover, the average $\overline{Y}$ value in the current study was 3.84, close to the 4.12 average of our earlier investigation. However, the variances of $\overline{Y}$s differed greatly across the two studies. In the earlier work, the variance of $\overline{Y}$ was 2.07, but in the present study it is only .80. The restricted variation in the present study could have depressed the relationships between $\overline{Y}$ and all of the other variables, and it may reflect the presence of an unidentified situational artifact.

It also is possible that the CA values of the RAT items had changed in the three years between the data collections of the two investigations. We know that there is geographical variation in the CA values of the items (Hood & Ginsburg, 1970a), and it may be that there is temporal fluctuation as well.

Another important hypothesis (Hyp. 8) did receive support, but the support was not conclusive. As predicted, the most rapid response of all was given by high $\overline{Y}$ Ss on their first response to Steep Slope words, under the NO CHAIN instructional set. The prediction was based on the assumption that people with well separated clusters (high $\overline{Y}$) would suffer no response competition and no confusion when giving a first response to stimulus words having a clearly dominant first associate in the language community (Steep Slope). As can be seen in Figure 3a, this indeed was the case. However, Figure 3b reveals that the difference was slight and nonsignificant under the CHAIN condition. Furthermore, the difference between high and low $\overline{Y}$s disappears by the second response; and the disappearance is due to an increase in response speed for the low $\overline{Y}$ groups and the high $\overline{Y}$-Flat Slope group, rather than the expected decrease in response speed for the high $\overline{Y}$-Steep Slope group.

Nevertheless, the high $\overline{Y}$ group did reflect community norms by responding so rapidly on the first response to Steep Slope words. This was reflected by the support for Hypotheses 6a, 6b and 8. It is the elevations and shapes of the curves in Figures 3a and 3b which force a conservative interpretation of the support. That is, the medium $\overline{Y}$ group should not have stood out above the other two $\overline{Y}$ groups, nor should the difference on the first response between the high $\overline{Y}$-Steep Slope condition and the other conditions involved in Hyp. 8 have disappeared because of an increase in the response speed under the other conditions from first to second response. That disappearance should have occurred simply because of an increased latency for the second response under the high $\overline{Y}$-Steep Slope condition.

FIGURE 3a: Response Latencies by Cluster Ratios ($\bar{Y}$), Word Slope and Responses, NO-CHAIN Condition

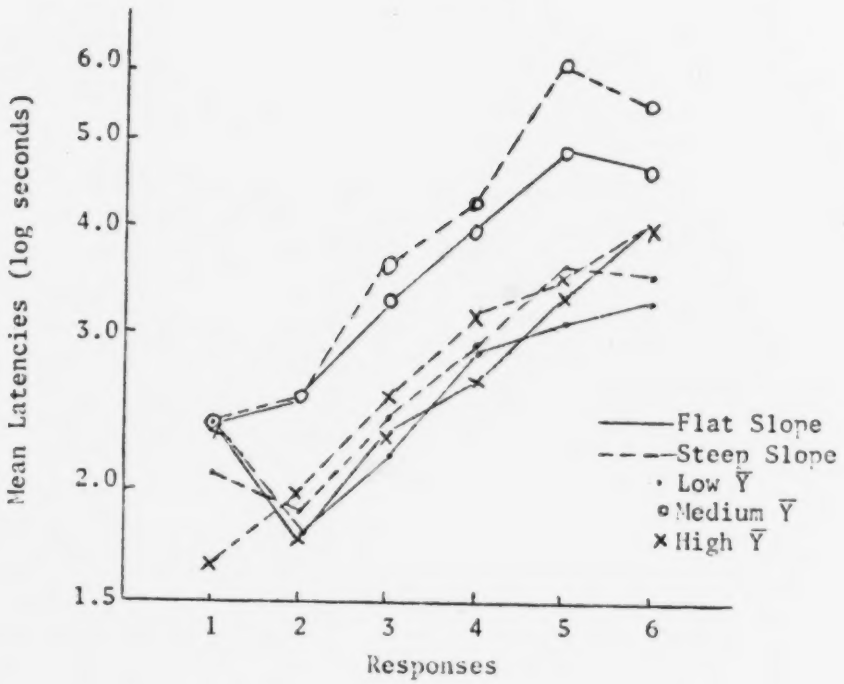
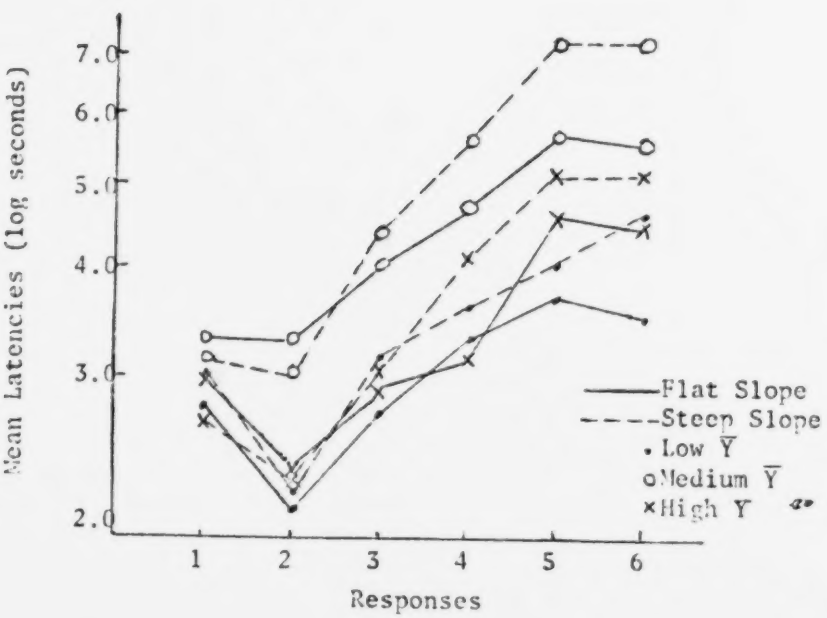


FIGURE 3b: Response Latencies by Cluster Ratios ($\bar{Y}$), Word Slope and Responses, CHAIN Condition



Thus, there is support for the underlying conceptions that $\bar{Y}$ reflects associative clustering, and that people with well separated clusters reflect community associative norms in their initial and subsequent responses. However, that support is made problematic by several other results: the inability to replicate our earlier finding of a strong, negative relationship between Hi CA RAT item scores and $\bar{Y}$ scores; the general similarity of high and low $\bar{Y}$ performances on all but their first response; the clear difference between the medium $\bar{Y}$ people and the other two groups; and the lack of any relationship between $\bar{Y}$ scores and OFT scores. These unexpected findings make necessary a general examination of the present data, separate from the original hypotheses, with the possibility of conceptual modification.

First, comparison can be made with the results of Olczak and Kaplan (1969). They, too, found a Slope x Response Number interaction (CD in the present report). However, they found (p. 160) that Flat Slope words produced greater latencies on the first response than Steep Slope words, and that the differences disappeared over subsequent responses. Our data indicate no differences until the third or fourth response, when Steep Slope words evoke dependably greater latencies than Flat Slope words (Fig. 1). Also, the trend analysis of Responses in our study identifies significant linear, quadratic and cubic trend components. Although Olczak and Kaplan do not report comparable trend data, their Figure 1 (p. 161) indicates a linear trend and possibly a quadratic trend, but certainly no cubic component (which would require an asymptotic or downward change by the sixth response). On the other hand, our data show a distinct asymptote by the fifth response.

Our linear and cubic components together imply a decrease and then continuous increase in latency of response, finally leveling out at five responses. This may reflect strength of association--decreasing steadily over responses, and reaching an asymptote by the fifth response. The initial drop in latency from the first to the second response may reflect selection of one of many possible subsets of responses of associations preceding the first overt response, and then a rapid second response from the same subset, rather than an anomalously greater strength of association for the second response than for the first. That is, the latency of the first response may reflect a cluster-selection activity as well as a brief common response-selection activity, while the latency of the second response would reflect only selection of a fairly common response.

The present data are similar to those of Olczak and Kaplan with respect to the influence of RAT performance on associative latencies. Neither total RAT score nor score on the ten Hi CA RAT items (see Table 3) yielded significant effects of any order. As noted earlier, our classification of RAT items into cultural availability categories may be in need of revision, but that would not explain the absence of effects using total RAT scores.

Another interesting aspect of the data is the influence of instructional set. When Ss were instructed to look back at the stimulus word after after each response in order to preclude response chaining, they responded more rapidly than in the absence of such instructions. The reason for this is unclear.

Perhaps most interesting is the surprising effect of $\overline{Y}$ classification (see Table 4). The main effect of $\overline{Y}$ (Factor A) is relatively meaningless in view of the significant AD interaction, and detailed analysis of that interaction (Table 5) revealed that the medium $\overline{Y}$ group took longer than the other two groups on their last three responses, and that the high and low $\overline{Y}$ groups did not differ from each other. This is shown in Figure 2 and in more detail in Figures 3a and 3b. This result is quite different from what had been expected, viz.--that the medium $\overline{Y}$ group would fall between the high and low $\overline{Y}$ groups. That is, the $\overline{Y}$ score is presumed to reflect the degree of separation among associative clusters, and there was no a priori reason to expect people with moderately separated clusters to respond different from the other groups, while people with well separated and poorly separated clusters respond the same.

Two possible explanations can be offered. First, it might be an artifact of either verbal fluency or verbal I.Q. Examination of fluency (numbers of words produced in the $\overline{Y}$ task) did reveal differences between the groups, but the differences were not significant ($F = 2.35$, $.10 < p < .25$). The possibility of differences in Verbal IQ cannot be assessed with the present data, although we do know that such differences could affect the results (Ginsburg & Whittemore, 1968). It might be that lower IQ people produce medium $\overline{Y}$ performance, while people with higher Verbal IQ produced either largely overlapping (low $\overline{Y}$) or clearly separated (high $\overline{Y}$) clusters.

On the other hand, the results may not be artifactual. In fact, it may well be that it is easier to operate within a single associative cluster until it is reasonably exhausted (high $\overline{Y}$) or within a cluster network with relatively unbounded clusters (low $\overline{Y}$) than within a network of partially overlapping clusters. In the latter case, the likelihood of one response leading to a weakly associated subsequent response would be much greater than in either of the more extreme cases. This can be cast in the general concentual framework suggested by Helen Peak (1958): For high $\overline{Y}$ people, there is very little probability of an element in one cluster leading to activation of an element in a second cluster, at least until most of the elements of the first cluster have been activated. Thus, high $\overline{Y}$ people should respond reasonably fast.

For low $\overline{Y}$ people, who have very weak and amorphous cluster formations, the question of intracluster vs. intercluster associations hardly arises. The probability of one element leading to activation of a second element will be--on the average for a given person--relatively high, since there are no between-cluster chasms. Low $\overline{Y}$ people, too, should respond relatively fast.

On the other hand, people with moderately overlapping clusters (medium $\overline{Y}$) do have a network of clusters, but the intercluster distances are small. Therefore, a reasonable probability exists of an element in one cluster activating an element in a second cluster rather than activating another element in its own cluster; but the activation may be slow due to intercluster distance and competition from elements within the original cluster. The result should be somewhat slower responding on the part of medium $\overline{Y}$ people.

Of course, this line of reasoning is highly speculative; the data were not anticipated in advance, and further research is necessary to explore their meanings.

Conclusions

This study constituted an attempt to relate associative clustering to other aspects of cognitive structure and cognitive processes. Expectations were generated on the basis of prior work, but the pattern of data was only partly in line with the expectations. Some of the divergencies are interesting and call for further research.

Specifically, associative clustering did not relate as expected to performance on those 10 RAT items whose answers are readily available as word associations to the stimulus words of the items. This raises questions about the differential sensitivity of people with varying degrees of cluster separation to focal and peripheral information in the environment. Such a relationship will have to be explored more directly through experimental laboratory research. The stability of the associative clustering scores strongly implies the presence of a within-person cognitive characteristic, and it would seem worthwhile to continue to search for the effect of that characteristic on sensitivity to peripheral information.

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